Claims

1. A method for transmitting data in a multi-carrier system where data from an individual user is transmitted on multiple subcarriers, the method comprising the steps of:

de-multiplexing a data stream to produce a plurality of de-multiplexed data streams;

spreading de-multiplexed data streams with a spreading code to produce a plurality of chip streams;

time shifting each chip stream by a predetermined amount; and

transmitting each time-shifted chip stream on a predetermined subcarrier.

2. The method of claim 1 further comprising the step of code multiplexing a spread pilot with the chip stream.

3. The method of claim 1 wherein differing spreading codes are used for at least two of the de-multiplexed data streams.

4. The method of claim 1 further comprising the steps of:

spreading a pilot stream to produce a spread pilot stream;

time shifting the pilot stream by a predetermined amount; and

transmitting the pilot stream on a predetermined subcarrier.

5. The method of claim 1 further comprising the steps of:

spreading a pilot stream to produce a spread pilot stream;

combining the pilot stream with a chip stream from the plurality of chip streams; and

wherein the step of time shifting each chip stream comprises the step of time shifting the combination of the pilot stream and the chip stream.

6. A method for transmitting data, the method comprising the steps of:

de-multiplexing a symbol stream to produce a plurality of de-multiplexed symbols;

spreading each symbol with a spreading code to produce a plurality spread symbols, each comprising a predetermined number of chips;

for a first transmission interval, mapping a first chip of a spread symbol to a predetermined subcarrier; and

for a second transmission interval, mapping the first chip of a spread symbol to a second subcarrier, wherein the second subcarrier differs from the first subcarrier.

7. The method of claim 6 further comprising the steps of:

spreading a pilot stream to produce a spread pilot stream comprising pilot chips; and

combining the pilot chips with chips of the spread symbols such that the chips mapped to the subcarriers comprise a combination of spread symbol chips and pilot chips.

8. The method of claim 6 wherein the de-multiplexed symbols comprises a code multiplexed pilot.

9. The method of claim 6 further comprising the step of, for the first transmission interval, mapping the spread symbol to subcarriers k to k+SF-1, and for the second transmission interval, mapping the spread symbol to m to m+SF-1, wherein SF is a spreading factor and k does not equal m.

10. A method comprising the steps of:

receiving a multicarrier signal comprising a plurality of subcarriers;

demodulating the multicarrier signal to produce a chip stream;

despreading the chip stream with a pilot code during a first symbol period to produce a first channel estimate for the first symbol period;

despreading the chip stream with the pilot code during a second symbol period to produce a second channel estimate for the second symbol period;

generating a third channel estimate only for a portion of the first symbol period based on the first and the second channel estimates; and

generating a fourth channel estimate for a second portion of the first symbol period based on the first and the second channel estimates.

11. The method of claim 10 wherein the multicarrier signal further comprises a code multiplexed pilot.

12. The method of claim 10 wherein the step of receiving the multicarrier signal comprises the step of receiving a multicarrier signal having relatively time-shifted chip streams existing on at least two subcarriers.

13. The method of claim 10 wherein the first and the second symbol period occur during a same time period and comprise chips transmitted on differing subcarriers.

14. The method of claim 10 wherein the first and the second symbol periods are non-overlapping in time.

15. The method of claim 10 wherein the first and the second symbol periods are non-overlapping in frequency.

16. An apparatus comprising:

a de-multiplexer, de-multiplexing a data stream to produce a plurality of de-multiplexed data streams;

a spreader spreading the de-multiplexed data streams with a spreading code to produce a plurality of chip streams;

a time shifter, time shifting each chip stream by a predetermined amount; and

a transmitter, transmitting each time-shifted chip stream on a predetermined subcarrier.

17. An apparatus comprising:

a de-multiplexer, de-multiplexing a symbol stream to produce a plurality of de-multiplexed symbols;

a spreader, spreading each symbol with a spreading code to produce a plurality spread symbols, each comprising a predetermined number of chips; and

a mapper, for a first transmission interval, mapping a first chip of a spread symbol to a predetermined subcarrier and for a second transmission interval, mapping the first chip of a spread symbol to a second subcarrier, wherein the second subcarrier differs from the first subcarrier.

18. An apparatus comprising:

a receiver, receiving a multicarrier signal comprising a plurality of subcarriers and demodulating the multicarrier signal to produce a chip stream;

a channel estimator, despreading the chip stream with a pilot code during a first symbol period to produce a first channel estimate for the first symbol period, and despreading the chip stream with the pilot code during a second symbol period to produce a second channel estimate for the second symbol period; and

an interpolator generating a third channel estimate only for a portion of the first symbol period based on the first and the second channel estimates and generating a fourth channel estimate for a second portion of the first symbol period based on the first and the second channel estimates.